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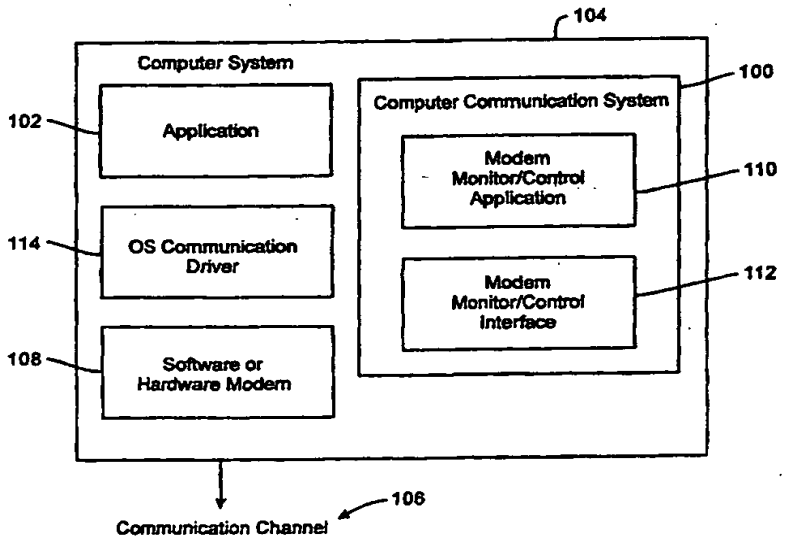

(57) Abstract

A communication system for monitoring and/or controlling communication parameters of a remote communication device. The communication system monitors a communication channel that is created between the remote communication device and controls the communication device by adjusting internal settings of the communication device that represent communication parameters. The communication device is communicatively coupled to a communication channel to carry out ongoing communications between the communication device and the communication channel. Further, a software module is associated with the communication device, and the software module accesses the internal settings of the communication device from a remote location via the communication channel and performs diagnostics such as monitoring, controlling, and configuring the communication device using the internal settings of the communication device.

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INTERNATIONAL APPLICATION
UNDER THE PATENT COOPERATION TREATY
(Attorney Docket No.: 98RSS027PCT)

TITLE: **Method and Apparatus for Monitoring, Controlling, and Configuring Remote Communication Devices**

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1. Technical Field

The present invention relates to communication systems and more particularly to a computer communication system that, among other things, monitors, controls, and diagnoses inefficiencies in communication parameters of the computer communication system while one computer system communicates with another computer system.

2. Background Art

In traditional implementations, control and monitoring of computer communication systems primarily concern monitoring and controlling internal parameters of modems and are performed through the use of modem control strings such as "AT commands". AT commands require a user to switch the modem from data to command mode so that the modem can be controlled with AT commands. Thus, AT commands interfere with the typical data flow of the modem and the commands do not reflect the true state of the modem in real time. Of note, in some traditional hardware modem implementations, limited control and status monitoring capabilities are obtained through adding special non-standard hardware interfaces. However, these special hardware interfaces are a relatively expensive solution to the problem of real time modem monitoring and the usage is limited due to its complexity.

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If the user chooses not to add the additional network equipment to retrieve the modem information, the user is forced to rely on verbal guidance from another person, such as a support technician, located at a second modem site. This support technician views the parameters of the modem connection from their end of the connection, performs a modem diagnosis based on available resources, and reports configuration options to the user for manual modem control and monitoring. Clearly, this process for modem monitoring and control is unsatisfactory because, among other things, the process requires detailed and easily misunderstood verbal instructions for modem configuration, the process requires the modem to be switched from data to command mode to enter the diagnostic commands for modem configuration, and at least two people are required to diagnose and configure a single modem. Thus, the monitor and configuration process is time consuming and frustrating for those involved.

Of current interest is a computer communication system that overcomes the disadvantages of the related art. Among other advantages and benefits, the computer communication system according to the principles of the present invention monitors, controls, and diagnoses inefficiencies in communication parameters of the computer communication system while one computer system communicates with another computer system. In one embodiment, the computer communication system provides a modem monitor and control system that provides modem monitoring and control without requiring user interaction or switching the modem between data and command modes.

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DISCLOSURE OF THE INVENTION

The principles according to the present invention can be realized through a communication system for monitoring, controlling, or configuring communication parameters of a remote communication device from a local communication system or a local communication device from a remote communication system. For example, the communication system monitors a communication channel that is created between two modems and controls the second modem by adjusting internal settings of the second modem that represent communication parameters. The second modem is communicatively coupled to the first modem to carry out ongoing communications between the first modem and the second modem through the communication channel. Further, a software module is associated with the first modem, and the software module accesses the internal settings of the second modem via the communication channel and performs diagnostics using the internal settings of the second modem. Of course, the software module could access the internal settings of the first modem directly and perform diagnostics using the internal settings of the first modem. Further, the software module can control the internal parameters of the either the second modem or the first modem regardless of which modem the software module is associated with.

The software module of the communication system typically includes a modem interface that interacts with the software module and assists the software module in performing diagnostics using the internal parameters of either the first or the second modem. Also, the software module accesses the communication channel transparently to the ongoing communications between the first modem and the second modem when the software module performs the diagnostics. Further, the software module accesses the communication channel without detrimentally affecting the ongoing communications between the first modem and the second modem. In another embodiment, the software module performs diagnostics using the internal parameters of the second modem via the same communication channel that is used to carry out ongoing communications between the first modem and the second modem. Of note, the software module can also control the internal parameters of the second modem.

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The diagnostics performed by the software module of the communication system include monitoring a data stream in the communication channel in view of the internal settings of the second modem. Further, the diagnostics performed by the software module comprise configuring the internal settings of the second modem based on information obtained regarding the data stream between the first modem and the second modem. In addition, the diagnostics performed by the software module comprise controlling the internal settings of the second modem according to information obtained regarding the data stream between the first modem and the second modem.

It should be noted that the software module may include either a user interactive interface for diagnostics, or an automatic interface for diagnostics that requires no further user interaction. Further, the communication system may include a plurality of software modules being associated, respectively, with each of a plurality of modems. Regardless of the number of modems in the communication system, the modems are communicatively coupled via a network. The network is typically selected from the group consisting of a local area network, a wide area network, and a global area network, however, the network may include any combination of a local, wide, or global area network. In other words, the network could operate according to almost any existing network protocol, e.g., a peer-to-peer network, a transmission control protocol/Internet protocol network (TCP/IP), etc.

In another embodiment, the present invention can be described as a communication system comprising a first communication device having internal parameters; a second communication device having internal parameters and being communicatively coupled to the first communication device; a communications link that passes a data stream between the first communication device and the second communication device; and a module associated with the communications link that adjusts the internal parameters of one of the communication devices based on characteristics of the internal parameters of either the first communication device, the second communication device, or both.

In this embodiment, the module may include a communication interface that interacts with the communications link such that the module operates transparently to the data stream of the communications link. Further, the first communication device may be a local

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communication device and the second communication device may be a remote communication device. In addition, similar to the first embodiment, the communications link operates on a network such as a local area network, a wide area network, or a global area network or a combination thereof. In many embodiments, the communication system is designed for modems operating in a computer communication system. Thus, to assist in understanding the principles according to the present invention, the exemplary embodiments are generally described using computer systems communicating with modems.

A method for adjusting parameters of a communication system includes steps such as establishing a communications link between a first communication device and a second communication device, each communication device having internal parameters influencing communication protocols on the communications link. In addition, the steps include obtaining a software module for interacting with the communications link; retrieving, with the software module, characteristics of the first communication device and/or the second communication device based on the internal parameters of the first communication device, the second communication device, or both, and based on data passing through the communications link; and adjusting the internal parameters according to the retrieved characteristics to optimize communication between the first and the second communication devices on the communications link.

Adjusting the internal parameters may include adjusting the internal parameters of the second communication device, the first communication device, or both. In addition, adjusting the internal parameters may include monitoring or controlling the internal parameters of the first, the second, or both communication devices. Further, retrieving characteristics of the second communication device may comprise retrieving the characteristics transparently to the data passing through the communications link and/or retrieving the characteristics such that the data passing through the communications link is not detrimentally affected.

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BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention can be obtained when the following detailed description of the preferred embodiment is considered in conjunction with the following drawings.

Figure 1 is a block diagram of an exemplary computer communication system according to the principles of the present invention wherein the system is associated with an application for providing a computer system access to a communication channel via a modem.

Figure 2 is a block diagram of an exemplary modem monitor/control interface of the computer communication system of Figure 1.

Figure 3 is a block diagram illustrating an exemplary modem for operation with the computer communication system of Figure 1.

Figure 4 is a block diagram of an exemplary computer communication system for monitoring and controlling both a local modem and a remote modem over a telephone line.

Figure 5 is a block diagram of exemplary computer communication systems operating modem monitor/control applications, respectively, on both a client modem and a server modem in a peer-to-peer network.

Figure 6 is a block diagram of exemplary computer communication systems operating modem monitor/control applications, respectively, on both a client modem and a server modem across the Internet.

Figure 7 is a block diagram of an exemplary computer communication system operating according to simple network management protocol (SNMP) parameters such that a management application performs remote trouble shooting of a modem.

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MODE(S) FOR CARRYING OUT THE INVENTION

Figure 1 is a block diagram of an exemplary computer communication system 100 that operates according to the principles of the present invention. For ease of understanding, the system 100 is associated with a computer software application 102 for providing a computer system 104 access to a communication channel 106 via a communication device such as a modem 108. The computer software application 102 is commonly a typical computer telecommunications application such as a "web browser", viz., Netscape™, Internet Explorer™, etc., or a modem utility, viz., Procomm™, etc. In short, the computer software application 102 utilizes the modem 108 capabilities to communicate with other modems through the communication channel 106. While the computer software application 102 uses the modem 108 to communicate with other modems, the computer communication system 100 examines the modem parameters of the modem 108 to determine if the modem configuration needs to be modified to attain optimal performance through the communication channel 106. As stated, the computer communication system 100 is an exemplary embodiment that is used to facilitate understanding of the principles according to the present invention. It should be understood that the present invention applies equally well to communication systems that operate with communication devices other than modems. However, for ease of understanding, the present invention will be described relative to computer communication systems using modems as the communication devices.

The computer communication system 100 includes a modem monitor/control application 110 that performs diagnostics on the modem 108 through a modem monitor/control interface 112 (the modem monitor/control application 110 and the modem monitor/control interface 112 sometimes collectively referred to herein as a "software module"). In one embodiment, the computer communication system 100 may perform these diagnostics through the same communication channel that the modem 108 uses to communicate with other modems. Thus, diagnostics can be performed on the "local" modem 108, on other "remote modems" (not shown in Figure 1), or on both.

Advantageously, the diagnostics can also occur transparently to ongoing communications in the communication channel. Thus, the modem communication connection, a.k.a., the "data stream", of the modem 108 can pass through the communication

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channel 106 without being detrimentally affected during diagnostics. Further, the diagnostics can be performed via user interaction through the modem monitor/control application 110 or, alternatively, the diagnostics can be performed independently of user interaction through the application 110. As stated, if any changes in the modem parameters are required to obtain optimal performance in the modem 108, the changes can be made without interruption in the data stream. Of course, the modem 108 could be a software modem or a hardware modem or any combination thereof, a pure software modem being defined as a modem implemented entirely in software and relying on a computer's processor to modulate and demodulate signals. Of note, the modem monitor/control interface 112 can be directly coupled to the modem 108 or the modem monitor/control interface 112 could instead be directly coupled to an operating system communication driver 114. These components can be combined in other manners as well. Further, the term "diagnostics", as used herein, refers to monitoring, controlling, or configuring a modem and also refers to other actions that computer software performs in relation to communication devices.

Figure 2 is a block diagram of the exemplary modem monitor/control interface 112 of the computer communication system 100. The modem monitor/control interface 112 includes a modem monitor/control application programming interface (API) 200, a modem monitor/control data link library (DLL) 202 that operates similarly to standard DLL software components, and a modem monitor/control driver 204 that operates similarly to standard software drivers. The API 200 provides code for monitoring and controlling a software modem while the modem is running or passing a data stream (see Appendixes A, B, and C). API 200 provides an easy method to write applications that provide various diagnostics that monitor parameters that change in real time (such as MSE, baud rate, echo canceller coefficiencies, etc.) as well as enabling the writing of applications that allow internal parameters to be modified while a telephony session is in progress. The API 200 can also provide easy means for field support by looking at various parameters and causing the modem to dump data into a file to be investigated later. Further, trouble shooting can be performed by changing various parameters while a data stream is running through the modem. Of note, in a preferred embodiment, the API 200 operates asynchronously and in parallel with the ordinary modem operation and does not interfere with the data stream.

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Thus, API 200 provides a true view of the modem parameters and does not slow the data transfer process.

Appendixes A, B, and C include exemplary embodiments of code portions of the API 200 and include three functions that could be considered the backbone of the API 200. First, the ModemConfigure function configures parameters within the modem and should be called only before the modem is activated. Second, the ModemControl function changes parameters within the modem to control the modem's operation and can be called during modem operation. Finally, the ModemMonitor function returns the current value of a parameter or set of parameters within the modem and can also be called during modem operation. The first parameter of the above functions is a code indicating which parameter (or parameter set) to monitor or change. The codes can be easily extended from time to time to provide additional visibility and control options for the modem. The same interfaces apply for additional parts of the modem such as speakerphone, tone detection/generation, etc. Thus, the computer communication system 100 is extendable and easy to use and can be used to monitor and control a modem without interfering with the ordinary operation of the modem. Further, the computer communication system 100 provides an easy method to develop applications for modem diagnostics and trouble shooting.

Figure 3 is a block diagram illustrating the exemplary modem 108 for operation with the computer communication system 100 that is associated with a computer system 104 for accessing a network. The exemplary modem 108 includes a port driver 300, a controller 302, a data pump abstraction layer 304, an advanced modem operation scheduler 306, a sample buffer management 308, a hardware interface 310, and signal processing tasks 312. Of course, the exemplary modem 108 could be realized in various manners depending on the number of components implemented in software. The components most suited for either a software or a hardware implementation are the controller 302 and the data pump abstraction layer 304. Thus, although other components can be implemented in either hardware or software, the controller 302 and the data pump abstraction layer 304 are most commonly implemented in either hardware or software.

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Figure 4 is a block diagram of an exemplary computer communication system 400 for monitoring and controlling, in a computer system 401, both a local modem 402 and a remote modem 404 of another computer system 405 over a telephone line 406. Similar to the computer communication system 100, the computer communication system 400 includes a modem monitor/control application 408 and a modem monitor/control interface 410. The local modem 402 can be monitored/controlled just as the modem 108 is monitored and controlled. In addition, the remote modem 404 can be monitored by the computer communication system 400 by using some of the bandwidth of the telephone line 406. Of course, if the communication devices were not modems and they communicated across something other than a telephone line, similar usage of the bandwidth on the line would enable functionality of the communication system 400.

Referring to the telephone line 406, a data stream is created between the local modem 402 and the remote modem 404 that represents a modem connection. The telephone line 406 is used to transfer modem diagnostics and/or control information to/from the remote modem 404 by either "stealing" some of the data bits or using an alternative channel whenever applicable (e.g., V.34 control channel). The extraction of the diagnostics can be performed in one of at least two manners:

1. A specific application can be run on the remote side that extracts modem parameters from the data stream and then sends them via the modem to the local side. The specific application can also receive control commands from the local modem and apply the commands to the remote modem.

2. The remote modem itself multiplexes the diagnostics in the data stream (or the control channel) and monitors control commands without any interference from outside. The multiplexing/demultiplexing can be performed on any of the following two levels: by a data pump, or by an active data protocol (V.42, V.17). This second implementation for extracting diagnostics from the data stream is particularly suitable for software modem implementations where the modem can

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be easily modified for that kind of data manipulation and a wide variety of modem parameters can be extracted (e.g., see ModemMonCtrl API of the Appendixes).

In this manner, modem parameters from the remote modem 404 can be monitored and the remote modem 404 can be controlled with new parameters being set in the remote modem 404 from the computer communication system 400. Of course, the data stream between the local modem 402 and the remote modem 404 is ongoing and, potentially, the data stream passes without interruption from the computer communication system 400 regardless of whether the modems are software, hardware, or combination software/hardware modems.

Figure 5 is a block diagram of exemplary computer communication systems operating modem monitor/control applications, respectively, on both a client modem 500 in a local computer system 501 and a server modem 502 in a remote computer system 503. The local and remote computer systems 501, 503 communicate across a peer-to-peer network 504. A client computer communication system 506 communicates with the client modem 500 while telecommunication software or application 508 having an operating system communication driver 510 uses the client modem 500 to maintain a modem connection across the peer-to-peer network 504. Similar to the computer communication systems 100 and 400, the client computer communication system 506 operates in a manner to monitor/control the client modem 500 by a client modem monitor/control application 509 or by the server modem 502 and a server computer communication system 512. The difference in this embodiment pertains to the computer communication systems including both the client computer communication system 506 and the server computer communication system 512. This arrangement is provided to ensure accurate monitoring and/or controlling of both server and client modems, whereby, the client modem 500 is monitored and controlled by a server modem monitor/control application 514. In addition, this embodiment demonstrates the flexibility of the system according to the present invention.

Figure 6 is a block diagram of exemplary computer communication systems operating modem monitor/control applications, respectively, on both a client modem 600 in a local computer system 601 and in a remote computer system 603. The local and remote computer systems 601, 603 communicate across a network 604. This embodiment illustrates a structure

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similar to Figure 5 except that, rather than peer-to-peer network 504, the local and remote computer systems 601, 603 communicate across a network 604 such as the Internet. Of course, the same advantages and benefits previously described in relation to modem monitoring, control, and diagnostics are realized when the modem 600 operates across the Internet through Internet service providers (ISPs). This extends the flexibility of the system by allowing the client modem 600 to be monitored and controlled from any remote computer system through connection to the server computer communication system 608. Of course, if communication devices other than modems are used to implement communication across the network 604, monitoring/controlling/configuring (i.e., diagnostics) can be performed in a similar manner as described herein.

Figure 7 is a block diagram of an exemplary computer communication system operating according to simple network management protocol (SNMP) parameters such that a management application 700 in a computer system 701 performs remote trouble shooting of a modem 702 in another computer system 703. This exemplary embodiment demonstrates how a single manager or system administrator monitors and controls numerous client modems across a network 704. The network 704 will commonly be a network such as the Internet. In this embodiment, SNMP serves as the underlying protocol for the management application 700 because SNMP is a common network management protocol. Thus, a single manager can monitor and control modems such as the modem 702. There is also no limitation as to where on the network 704 that the manager resides, as long as the manager has access to the server. Additional computer systems 706 are illustrated and are used as support tools for the management application 700. The additional computer systems 706 each support a modem web page 708 that enables remote diagnostics of the modem 702 from anywhere on the network 704. Of course, other network management protocols could be used to implement the principles according to the present invention and the description of SNMP operating over the network 704 should not be construed to limit the appended claims.

The above-listed sections and included information are not exhaustive and are only exemplary for certain computer/modem/network systems. The particular sections and included information in a particular embodiment may depend upon the particular

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implementation and the included devices and resources. Although a system and method according to the present invention has been described in connection with the preferred embodiments, it is not intended to be limited to the specific form set forth herein, but, on the contrary, it is intended to cover such alternatives, modifications, and equivalents as can be reasonably included within the spirit and scope of the invention as defined by the appended claims.

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Appendix A

```
#ifndef _MODEM_CTRL_H_
#define _MODEM_CTRL_H_

#include <Windows.h>    // To provide types definition, can be replaced by
any alternative type defining file
#include "ModemCodes.h"

#ifdef  __cplusplus
extern "C" {
#endif

      VOID WINAPI ModemGetLastError( PCHAR pBuf, DWORD nBuf );

/*
The GetModemCodesVersion function returns the version of the control codes
header file.
It should be used to verify cohernece between the modem control API user
and provider.
*/

      DWORD WINAPI ModemGetCodesVersion();


/*
The ModemOpen function returns a handle that can be used to access
a data-pump object.

Parameters:
dwDpIdCode - Specifies the type identification code of the data pump.
      This value identifies the specific data pump to be monitored or
controled.
      The data pump type identification codes are defined by the type
RK_DP_IDS
      (file "ModemCodes.h").

Return Values:
If the specified data pump type exists and the function succeeds,
the return value is an open handle to the specified modem.
If the function fails, the return value is INVALID_HANDLE_VALUE.
*/

 HANDLE WINAPI ModemOpen(
      DWORD dwDpIdCode
   );


/*
The ModemClose function closes an open object handle.

Parameters:
hModem - Identifies an open object handle to one of the following objects:
```


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CModem

```
Return Values:
If the function succeeds, the return value is TRUE.
If the function fails, the return value is FALSE.
*/

 BOOL WINAPI ModemClose(
    HANDLE hModem       // handle to object to close
   );


/*
The functions: ModemConfigure, ModemControl, ModemMonitor
send a control code to a specified CModem object,
causing the corresponding device to perform the specified operation.
ModemConfigure has to be called BEFORE the specified modem has been
activated.
ModemControl and ModemMonitor may be called DURING modem operation.

Parameters:
hModem - Handle to the CModem instance that is to perform the operation.
            Call the CreateModem function to obtain a CModem handle.
dwConfigCode/dwControlCode/dwMonitorCode - Specify the control code for the
operation.
            This value identifies the specific configuration to be
performed by
            ModemConfigure/ModemControl/ModemMonitor respectively.
            The control codes are defined by types
RK_CFG_CODES/RK_CTL_CODES/RK_MON_CODES
            (file "ModemCodes.h").
pInBuffer - Pointer to a buffer that contains the data required to perform
the operation.
            This parameter can be NULL if the dwConfigCode parameter
specifies an operation
            that does not require input data.
nInBufferSize - Specifies the size, in bytes, of the buffer pointed to by
pInBuffer.
pOutBuffer - Pointer to a buffer that receives the operation's output data.
            This parameter can be NULL if the dwConfigCode parameter
specifies an operation
            that does not produce output data.
nOutBufferSize - Specifies the size, in bytes, of the buffer pointed to by
pOutBuffer.
pBytesReturned - Pointer to a variable that receives the size, in bytes,
            of the data stored into the buffer pointed to by pOutBuffer.

Return Values:
If the function succeeds, the return value is TRUE.
If the function fails or the specified operation is not supported
for the specified object, the return value is FALSE.
*/

 BOOL WINAPI ModemConfigure(
```


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```
    HANDLE  hModem,                 // handle to CModem instance of
interest
    DWORD   dwConfigCode,       // control code of operation to perform
    PVOID   pInBuffer,          // pointer to buffer to supply input data
    DWORD   nInBufferSize,      // size of input buffer
    PVOID   pOutBuffer,         // pointer to buffer to receive output data
    DWORD   nOutBufferSize,     // size of output buffer
    PDWORD  pBytesReturned      // pointer to variable to receive output byte
count
    );

 BOOL WINAPI ModemControl(
    HANDLE  hModem,                 // handle to CModem instance of
interest
    DWORD   dwControlCode,      // control code of operation to perform
    PVOID   pInBuffer,          // pointer to buffer to supply input data
    DWORD   nInBufferSize,      // size of input buffer
    PVOID   pOutBuffer,         // pointer to buffer to receive output data
    DWORD   nOutBufferSize,     // size of output buffer
    PDWORD  pBytesReturned      // pointer to variable to receive output byte
count
    );

 BOOL WINAPI ModemMonitor(
    HANDLE  hModem,                 // handle to CModem instance of
interest
    DWORD   dwMonitorCode,      // control code of operation to perform
    PVOID   pInBuffer,          // pointer to buffer to supply input data
    DWORD   nInBufferSize,      // size of input buffer
    PVOID   pOutBuffer,         // pointer to buffer to receive output data
    DWORD   nOutBufferSize,     // size of output buffer
    PDWORD  pBytesReturned      // pointer to variable to receive output byte
count
    );

#ifdef  __cplusplus
}
#endif

#endif //_MODEM_CTRL_H_
```


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Appendix B

```
#ifndef _MODEM_CODES_H_
#define _MODEM_CODES_H_

#define MODEM_CODES_VERSION                8

// rate masks returned by RKMON_SUPPORTED_BIT_RATE
#define RK_RATE_MASK_75                    0x00000001
#define RK_RATE_MASK_300                   0x00000002
#define RK_RATE_MASK_600                   0x00000004
#define RK_RATE_MASK_1200                  0x00000008
#define RK_RATE_MASK_2400                  0x00000010
#define RK_RATE_MASK_4800                  0x00000020
#define RK_RATE_MASK_7200                  0x00000040
#define RK_RATE_MASK_9600                  0x00000080
#define RK_RATE_MASK_12000                 0x00000100
#define RK_RATE_MASK_14400                 0x00000200
#define RK_RATE_MASK_16800                 0x00000400
#define RK_RATE_MASK_19200                 0x00000800
#define RK_RATE_MASK_21600                 0x00001000
#define RK_RATE_MASK_24000                 0x00002000
#define RK_RATE_MASK_26400                 0x00004000
#define RK_RATE_MASK_28800                 0x00008000
#define RK_RATE_MASK_31200                 0x00010000
#define RK_RATE_MASK_33600                 0x00020000
#define RK_RATE_MASK_32000                 0x00040000
#define RK_RATE_MASK_34000                 0x00080000
#define RK_RATE_MASK_36000                 0x00100000
#define RK_RATE_MASK_38000                 0x00200000
#define RK_RATE_MASK_40000                 0x00400000
#define RK_RATE_MASK_42000                 0x00800000
#define RK_RATE_MASK_44000                 0x01000000
#define RK_RATE_MASK_46000                 0x02000000
#define RK_RATE_MASK_48000                 0x04000000
#define RK_RATE_MASK_50000                 0x08000000
#define RK_RATE_MASK_52000                 0x10000000
#define RK_RATE_MASK_54000                 0x20000000
#define RK_RATE_MASK_56000                 0x40000000

// DataPump type codes
typedef enum {
      RKID_V32BIS = 0,
      RKID_V34,
      RKID_V22BIS,
      RKID_V23,
      RKID_V21,

      RKID_V17,
      RKID_V29,
      RKID_V27,

      RKID_V8,
```


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```
        RKID_TONE_DET,
        RKID_TONE_GEN,
        RKID_DTMF_DET,
        RKID_DTMF_GEN,
        RKID_CR_TONE_DET,
        RKID_CR_TONE_GEN,

        RKID_RKSAMPLE,
        RKID_ANS_DET,
        RKID_ANS_GEN,
        RKID_WINAC,
        RKID_ROKV42,

        RKID_K56FLEX,
        RKID_BELL103,
        RKID_BELL212A,
        RKID_SPKP,
        RKID_VOICE,

        RKID_V90,

        RKID_AMOS,

        RKID_LAST,
    } RK_DP_IDS;


    // Offset definitions:
    #define COMMON_RK_CODES        0

    #define RKSAMPLE_RK_CODES   2000
    #define WINAC_RK_CODES      3000
    #define V42_RK_CODES        4000

    #define AUTOMODE_RK_CODES   6000
    #define V8_RK_CODES         7000        // V8, V8BIS

    #define V21_RK_CODES       10000
    #define V22_RK_CODES       11000        // V22, Bell-212A
    #define FSK_RK_CODES       12000        // V23, Bell-103

    #define FAX_RK_CODES       14000        // V27, V27BIS, V27TER, V29, V17

    #define V32_RK_CODES       16000        // V32, V32BIS

    #define V34_RK_CODES       18000

    #define V90_RK_CODES       20000        // K56FLEX, V90

    #define SPKP_RK_CODES      25000

    #define VOICE_RK_CODES     26000

    #define AMOS_RK_CODES      27000
```


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```
// Modem Config Codes                                          Parameter
(In)        Parameter (Out)
typedef enum
{
// ********* Common Constants **********

      // Select Symbol Rate (no impact if Autorate is enabled)
      RKCFG_TX_SYMBOL_RATE = COMMON_RK_CODES,   //                INT -
Symbol Rate None
      RKCFG_RX_SYMBOL_RATE,                                 //              INT
- Symbol Rate     None
      // Force Bit Rate
      RKCFG_BIT_RATE_RX_MAX,                                //              INT
- Bit Rate        None
      RKCFG_BIT_RATE_TX_MAX,                                //              INT
- Bit Rate        None
      RKCFG_BIT_RATE_RX_MIN,                                //              INT
- Bit Rate        None
      RKCFG_BIT_RATE_TX_MIN,                                //              INT
- Bit Rate        None

      // Select connection type ( Half or Full Duplex )
      RKCFG_CONNECTION_TYPE,                                //      DWORD
(FDplex=0,HDplex=1)     None

      // Tx Transmittion Power: {Minimum, Maximum, Default, Offset}
      // (values in dBm, offset in dB). Offset is for compensation on
hardware gain.
      RKCFG_TX_SIGNAL_POWER,                                //
      char[4]                 None

      // Enable/Disable Rate Renegotiation
      RKCFG_RENEG_ENABLE,                                         //
      BOOL - Yes/No           None
      // Enable/Disable Retrain
      RKCFG_RETRAIN_ENABLE,                                 //
      BOOL - Yes/No           None

      // Enable/Disable Rx Freeze
      RKCFG_RX_FREEZE_ENABLE,                               //
      BOOL - Yes/No           None
      // Enable/Disable Echo Canceller Freeze
      RKCFG_EC_FREEZE_ENABLE,                               //
      BOOL - Yes/No           None

      RKCFG_RECORD_SESSION,                                 //
      BOOL - Yes/No           None
      RKCFG_SESSION_NAME,                                         //
      char * name             None

      RKCFG_NO_CARRIER_TIMEOUT,                             //
      DWORD - in seconds      None
```


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```
        RKCFG_START_AT_DATA,                                    //
        BOOL - Yes/No           None

        RKCFG_REMOTE_IS_ROCKWELL,                               //
        BOOL - Yes/No           None

        RKCFG_MODEM_SETTINGS,
    // ********* Win AC Constants *************

        RKCFG_EC_MODE = WINAC_RK_CODES,                         //
        DWORD(ERROR_CONTROL_MODE)
        RKCFG_CMPRS_MODE,                                       //
        DWORD(COMPRESSION_MODE)
        RKCFG_ACTIVE_MODULATION,                                //
        DWORD(RK_DP_IDS)

    // ********* Auto-Mode Constants **********

        // Enable/Disable Automode
        RKCFG_AUTOMODE_ENABLE =AUTOMODE_RK_CODES,//                BOOL -
    Yes/No          None

        // Transmit Timeout for detection for V32
        RKCFG_TRANSMIT_TIMEOUT,                                 //
        DWORD ms    None


    // ********* V8  Constants **********

        RKCFG_V8_SUPPORT_CI    = V8_RK_CODES,       //             BOOL -
    Yes/No          None

        RKCFG_V8_CI_CALLING_FUNCTION_SEQUENCE,     //             BYTE
                    None

        RKCFG_V8_CI_ON_CADENCE,                                 //
        DWORD ms cadence  None
        RKCFG_V8_CI_OFF_CADENCE,                                //
        DWORD ms cadence  None
        RKCFG_V8_AS_CI_DET,                                          //
        BOOL                    None
    // ********* V21 Constants **********

        RKCFG_V21RX_HIGH_CHANNEL = V21_RK_CODES,//                 BOOL -
    Yes/No          None
        RKCFG_V21TX_HIGH_CHANNEL,                               //
        BOOL - Yes/No           None

        RKCFG_V21_DATA_MODE,                                    //
        BOOL                    None

    // ********* V22 Constants (V22, Bell-212A) **********

        RKCFG_V22_TO_BELL_212A = V22_RK_CODES,     //             BOOL -
    Yes/No          None
```


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```
// ********* FSK Modulations Constants (V23, Bell-103) **********

      RKCFG_FSK_BACK_CHANNEL = FSK_RK_CODES,     //                BOOL -
Yes/No            None

      RKCFG_FSK_V23_CHANNEL,                              //
      BOOL - Yes/No           None

      RKCFG_FSK_BELL103_CHANNEL,                          //
      BOOL - Yes/No           None

      RKCFG_FSK_FOR_CID,                                  //
      BOOL - Yes/No           None
// ********* Fax Constants (V27, V29, V17) **********

      // Define Retrain between Pages as Short or Long
      RKCFG_LONG_RETRAIN      = FAX_RK_CODES,    //              BOOL
(TRUE=Long) None

// ********* V32 Constants **********

      RKCFG_V32BIS_TO_V32     = V32_RK_CODES,    //              BOOL -
      Yes/No            None
      RKCFG_V32_TRELLIS_SUPPORT,                          //
      BOOL -      Yes/No            None

// ********* V34 Constants **********

      // Select Carrier Frequency
      RKCFG_RX_CARRIER_FREQ  = V34_RK_CODES,     //
      V34_carrier_t           None

      // Enable/Disable Transmit Power Drop
      RKCFG_TX_POWER_DROP_ENABLE,                         //
      BOOL - Yes/No           None
      // Select Transmit Power Level
      RKCFG_TX_POWER_DROP,                                //                INT
- Level                 None
      // Select Requested Power Drop
      RKCFG_REQUESTED_POWER_DROP,                         //
      DWORD                   None

      // Enable/Disable Precoding
      RKCFG_PRECODING_ENABLE,                             //
      BOOL - Yes/No           None
      // Set Precoding Coefficients
      RKCFG_PRECODING_COEFFS,                             //    SHORT[6] -
Array of coeffs   None

      // Transmitter Preemphasis Filter
      RKCFG_TX_PREEMPHASIS_FILTER,              //              INT -
Filter Index      None
      // Requested Preemphasis Filter
```


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```
        RKCFG_REQUESTED_PREEMPHASIS_FILTER,        //                INT -
    Filter Index       None

        // Enable/Disable Constellation Expansion
        RKCFG_CONSTELATION_EXPAND_ENABLE,          //                BOOL -
    Yes/No             None
        // Enable/Disable Warping
        RKCFG_WARP_ENABLE,                                      //
        BOOL - Yes/No              None
    // ********* V90 Constants (K56FLEX, V90) **********

        // set the encoding law for flex 1 indicates A-law coding,0 indicates
    u-law
        RKCFG_ENCODING_LAW    = V90_RK_CODES,      //                BOOL
    (TRUE=A_Law)       None

    // ********* SpeakerPhone Constants **********

        // Hardware Delay
        RKCFG_EC_DELAY     = SPKP_RK_CODES,        //{SPKP_MODULE,INT - No of
    Samples}     None
        // Cross-Correlator Length
        RKCFG_CC_LENGTH,                                  //                INT
    - No of Taps       None

        RKCFG_DMP_MASK,

        RKCFG_INITIAL_FULL_DUPLEX_MEASURE,

    } RK_CFG_CODES;

    // Modem Control Codes
    typedef enum
    {
    // ********* Common Constants **********

        // Initiate Retrain
        RKCTL_RETRAIN     = COMMON_RK_CODES,       //                None
                  None
        // Initiate Rate Renegotiation
        RKCTL_RENEG,                                            //
        INT - Bit Rate             None
        // Terminate Connection Gracefully
        RKCTL_CLEARDOWN,                                  //
        None                       None

        // Squelch Tx Signal
        RKCTL_TX_SQUELCH,                                 //
        None                       None

        // Use the SendCommand
        RKCTL_SEND_COMMAND,                                     //
    {DWORD[2]- Command, Param}     None

        // WinAC constants
```


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```
        RKCTL_MODEM_SLEEP = WINAC_RK_CODES,        //                  DWORD
                    None

    // ********* Fax Constants (V27, V29, V17) **********

        // Define Retrain between Pages as Short or Long
        RKCTL_LONG_RETRAIN    = FAX_RK_CODES,      //                  BOOL
    (TRUE=Long) None

    // ********* V34 Constants **********

        // Must be sent before RKMON_DATA_RES_ECHO_GET
        RKCTL_DATA_RES_ECHO_REQUEST=V34_RK_CODES,//                  None
                    None

    // ********* SpeakerPhone Constants **********

        // Speakerphone Mode (FD, HD, HS)
        RKCTL_SPKP_MODE       = SPKP_RK_CODES,     //                  SPKPMode
                    None
        // Output Mute
        RKCTL_IO_MUTE,                                          //
        {SPKP_PROBE,BOOL - Yes/No}     None
        // Echo Cancellers
        RKCTL_FILTER_LENGTH,                        //  {SPKP_MODULE,INT - No
    of Taps}     None
        RKCTL_EC_OPERATE,                           //     {SPKP_MODULE,BOOL -
    Yes/No}            None
        RKCTL_ADAPT_ENABLED,                        //     {SPKP_MODULE,BOOL -
    Yes/No}            None
        // AGC and Sw-Loss
        RKCTL_AMP_ENABLED,                                  //
        {SPKP_MODULE,BOOL - Yes/No}          None
        // Gains
        RKCTL_GAIN,                // {SPKP_MODULE*,INT*/FLOAT* -
    Gain,GAIN_FORMAT*}       None

        RKCTL_INIT_GAIN,
        RKCTL_MAX_GAIN,
        RKCTL_FULL_DUPLEX_MEASURE,

        RKCTL_NOISE_INSERTION_LENGTH,
        RKCTL_NOISE_INSERTION_ENABLE,

        RKCTL_FADE_IN_LENGTH,
        RKCTL_FADE_IN_ENABLE,

        RKCTL_UPSTEP,

        RKCTL_MIN_LINE_OUT_POWER,

        RKCTL_LINE_OUT_SILENCE_GAIN_REDUCTION,

    // ********* AMOS Constants **********
        RKCTL_CREATE_DATAPUMP = AMOS_RK_CODES,
```


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```
        RKCTL_DESTROY_DATAPUMP,

    } RK_CTL_CODES;

// Modem Monitor Codes
typedef enum
{
// ********* Common Constants **********

        RKMON_TX_SAMPLE_RATE = COMMON_RK_CODES,    //                  None
                DWORD - Sample Rate
        RKMON_RX_SAMPLE_RATE,                                  //
        None                    DWORD - Sample Rate
        RKMON_TX_SYMBOL_RATE,                                  //
        None                    INT - Symbol Rate
        RKMON_RX_SYMBOL_RATE,                                  //
        None                    INT - Symbol Rate
        RKMON_TX_BIT_RATE,                                             //
        None                    INT - Bit Rate
        RKMON_RX_BIT_RATE,                                             //
        None                    INT - Bit Rate

        RKMON_TX_CARRIER_FREQUENCY ,               //                  None
                DWORD - (Hz)
        RKMON_RX_CARRIER_FREQUENCY ,               //                  None
                DWORD - (Hz)
        RKMON_TX_SIGNAL_POWER ,                                //
        None                    Float - (dBm)
        RKMON_RX_SIGNAL_POWER ,                                //
        None                    Float - (dBm)

        // Constellation points
        RKMON_RX_SCATTER,                                      //
        None                    float* - pointer to pairs of points
        // Gain needed for scatter plot
        RKMON_RX_NORM_FACTOR,                                  //
        None                    float

        RKMON_ROUND_TRIP_DELAY,                                //
        None                    INT - R.T.D in 8k samples per sec.

        // M.S.E at Rate selection [dB]
        RKMON_BASE_MSE,                                                //
        None                    Float
        // Mean Square Error [dB]
        RKMON_MSE,                                                     //
        None                    Float

        // Signal to Noise Ratio (dB)
        RKMON_SNR ,                                                    //
        None                    Float
        RKMON_EQM ,                                                    //
        None                    float - (dB)
```


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```
        RKMON_SUPPORTED_BIT_RATES_MASK ,          //                None
                    DWORD (masks of RK_RATE_MASK_ defined above)
        RKMON_FE_ECHO_DELAY,

        RKMON_AUDIO_TX_SAMPLE_RATE,                        //
        None                    DWORD - Sample Rate
        RKMON_AUDIO_RX_SAMPLE_RATE,                        //
        None                    DWORD - Sample Rate

        RKMON_SETTINGS_INFO,
        RKMON_SETTINGS_BLOCKS,
    // ********* Rksample Constants **********

        // Num of microseconds in last interrupt
        RKMON_LAST_INT_CPU = RKSAMPLE_RK_CODES,    //                None
                    DWORD
        // Num of microseconds between last 2 interrupts
        RKMON_LAST_INT_LATENCY ,                           //
        None                    DWORD
        // Num of microseconds in longest interrupt
        RKMON_MAX_INT_CPU ,                                          //
        None                    DWORD
        // Longest latency between 2 interrupts (microseconds)
        RKMON_MAX_INT_LATENCY ,                            //
        None                    DWORD
        // Num of samples overrun occcurred in the past
        RKMON_SAMPLES_OVERRUNS ,                           //
        None                    DWORD
        // Num of samples occcurred in the past
        RKMON_SAMPLES_UNDERRUNS,                           //
        None                    DWORD
        // Num of bus overruns occcurred in the past
        RKMON_BUS_OVERRUNS ,                               //
        None                    DWORD
        // Num of bus underruns occcurred in the past
        RKMON_BUS_UNDERRUNS,                               //
        None                    DWORD
        // Operating speed
        RKMON_OPERATING_SPEED,                             //
        None                    DWORD

    // ********* WinAc Constants **********

        // Index (WinAc style) of the active modulation
        RKMON_ACTIVE_MODULATION=WINAC_RK_CODES,    //                None
                    DWORD
        RKMON_MODEM_STATE,                                           //
        None                    DWORD
        RKMON_MODEM_SLEEP,                                           //
        None                    DWORD
        // RKMON_CALL_SETUP_RES - identical
        // to field no. 1 in AT#UD
        RKMON_CALL_SETUP_RES,                              //
        None                    DWORD
        // RKMON_MULTI_MEDIA_MODE - identical
```


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```
        // to field no. 2 in AT#UD
        RKMON_MULTI_MEDIA_MODE,                          //
        None                    DWORD
        // RKMON_V8_CM - identical to field no.
        // 4 in AT#UD. Returns a pointer to string.
        RKMON_V8_CM,                                     //
        None                    PCHAR
        // RKMON_V8_JM - identical to field no.
        // 5 in AT#UD. Returns a pointer to string.
        RKMON_V8_JM,                                     //
        None                    PCHAR
        // RKMON_TX_NEG_RES - identical to
        // field no. 20 in AT#UD
        RKMON_TX_NEG_RES,                                //
        None                    DWORD
        // RKMON_RX_NEG_RES - identical to
        // field no. 21 in AT#UD
        RKMON_RX_NEG_RES,                                //
        None                    DWORD
        // RKMON_CARRIER_LOSS_EV_CNT -
        // identical to field no. 30 in AT#UD
        RKMON_CARRIER_LOSS_EV_CNT,                       //
        None                    DWORD
        // RKMON_RATE_RENEG_EV_CNT -
        // identical to field no. 31 in AT#UD
        RKMON_RATE_RENEG_EV_CNT,                         //
        None                    DWORD
        // RKMON_RTRN_REQ - identical to field
        // no. 32 in AT#UD
        RKMON_RTRN_REQ,                                  //
        None                    DWORD
        // RKMON_RTRN_GRANTED - identical to
        // field no. 33 in AT#UD
        RKMON_RTRN_GRANTED,                              //
        None                    DWORD
        // RKMON_PROTOCOL_NEG_RES - identical
        // to field no. 40 in AT#UD
        RKMON_PROTOCOL_NEG_RES,                          //
        None                    DWORD
        // RKMON_EC_FRAME_SIZE - identical to
        // field no. 41 in AT#UD
        RKMON_EC_FRAME_SIZE,                             //
        None                    DWORD
        // RKMON_EC_LINK_TIMEOUTS - identical
        // to field no. 42 in AT#UD
        RKMON_EC_LINK_TIMEOUTS,                          //
        None                    DWORD
        // RKMON_EC_LINK_NAKS - identical to
        // field no. 43 in AT#UD
        RKMON_EC_LINK_NAKS,                              //
        None                    DWORD
        // RKMON_CMPRS_NEG_RES - identical to
        // field no. 44 in AT#UD
        RKMON_CMPRS_NEG_RES,                             //
        None                    DWORD
```


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```
        // RKMON_CMPRS_DICT_SIZE - identical to
        // field no. 45 in AT#UD
        RKMON_CMPRS_DICT_SIZE,                          //
        None                    DWORD
        // RKMON_TX_FLOW_CTRL - identical to
        // field no. 50 in AT#UD
        RKMON_TX_FLOW_CTRL,                             //
        None                    DWORD
        // RKMON_RX_FLOW_CTRL - identical to
        // field no. 51 in AT#UD
        RKMON_RX_FLOW_CTRL,                             //
        None                    DWORD
        // RKMON_TOTAL_TX_CHARS - identical to
        // field no. 52 in AT#UD
        RKMON_TOTAL_TX_CHARS,                           //
        None                    DWORD
        // RKMON_TOTAL_RX_CHARS - identical to
        // field no. 53 in AT#UD
        RKMON_TOTAL_RX_CHARS,                           //
        None                    DWORD
        // RKMON_TERMINATION_CAUSE - identical
        // to field no. 60 in AT#UD
        RKMON_TERMINATION_CAUSE,                        //
        None                    DWORD
        // RKMON_CALL_WAIT_EV_CNT - identical
        // to field no. 61 in AT#UD (not supported)
        RKMON_CALL_WAIT_EV_CNT,                         //
        None                    DWORD
        RKMON_CPU_VENDOR,                               //
        None                    PCHAR
        RKMON_CACHE_SIZE,                               //
        None                    DWORD
        RKMON_NUMBER_CALLED,                            //
        None                    PCHAR
      RKMON_TIMER_RESOLUTION,                           //              None
                    DWORD

    // ********* V42 Constants **********

        // Number of V42 BLERS
        RKMON_BLER              = V42_RK_CODES,     //              None
                    DWORD

    // ********* Fax Constants (V27, V29, V17) **********

        // Whether Retrain between Pages is Short or Long
        RKMON_LONG_RETRAIN      = FAX_RK_CODES,     //              None
                    BOOL (TRUE=Long)

    // ********* V34 Constants **********

        // Transmit Power Drop [dB]
        RKMON_TX_POWER_DROP     = V34_RK_CODES,     //              None
                    INT
        // Power Drop [dB] that was requested from remote modem
```


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```
        RKMON_RX_POWER_DROP,                                    //
        None                    INT

        // Transmitter Preemphasis Filter
        RKMON_TX_PREEMPHASIS_FILTER,            //              None
                INT - Filter Index
        // other side's Preemphasis Filter
        RKMON_RX_PREEMPHASIS_FILTER,            //              None
                INT - Filter Index


        // Residual Echo in training [dB]
        RKMON_TRN_RESIDUAL_ECHO,                                //
        None                    Float
        // Residual Echo in data [dB]   (must be sent after
    RKCTL_DATA_RES_ECHO_REQUEST)
        RKMON_DATA_RES_ECHO_GET,                                //
        None                    Float
        // Near End Echo [dB]
        RKMON_NE_ECHO_POWER,                                    //
        None                    Float
        // Far End Echo [dB]
        RKMON_FE_ECHO_POWER,                                    //
        None                    Float

        // Timing Drift [ppm]
        RKMON_TIMING_DRIFT,                                             //
        None                    Float
        // Frequency Offset [Hz]
        RKMON_FREQ_OFFSET,                                              //
        None                    Float

    // ********* V90 Constants (K56FLEX, V90) **********

        // Robbed Bits Signaling
        RKMON_RBS_DETECTED    = V90_RK_CODES,           //              None
                DWORD  RBS frame 0 to 63  (1' indicate robbed bit)
        // PCM Pad
        RKMON_PAD_DETECTED,                                             //
        None                DWORD  PAD 0=NORMAL ,3=3dBPad 6=6dBPad

        // High Pass filter enabled
        RKMON_HIGHPASS_FILTER_ENABLED ,                         //
        None                    BOOL - Yes/No

    // ********* SpeakerPhone Constants **********

        // Speakerphone Mode (FD, HD, HS)
        RKMON_SPKP_MODE       = SPKP_RK_CODES,          //              None
                SPKPMode
        // State
        RKMON_STATE,                                                    //
        None                    SPKPState
        // Input-Output Mute
```


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```
        RKMON_IO_MUTE,                                          //
        SPKP_PROBE              BOOL - Yes/No
        RKMON_SATURATION,                                   //
        SPKP_PROBE              BOOL - Yes/No
        RKMON_DC_LEVEL,                                         //
        SPKP_PROBE              FLOAT
        // Echo Cancellers
        RKMON_FILTER_LENGTH,                                //
        SPKP_MODULE             INT - No of Taps
        RKMON_EC_OPERATE,                                   //
        SPKP_MODULE             BOOL - Yes/No
        RKMON_ADAPT_ENABLED,                                //
        SPKP_MODULE             BOOL - Yes/No
        RKMON_EC_DELAY,                                         //
        SPKP_MODULE             INT - No of Samples
        // AGC and Sw-Loss
        RKMON_AMP_ENABLED,                                      //
        SPKP_MODULE             BOOL - Yes/No
        // Powers
        RKMON_POWER,                                            //
        SPKP_PROBE              FLOAT - Power [dB]
        RKMON_NOISE_POWER,                                      //
        SPKP_PROBE              FLOAT - Power [dB]
        // Gains
        RKMON_GAIN,                                             //
{SPKP_MODULE,GAIN_FORMAT}       INT/FLOAT - Gain [Scaled,dB,Linear]
        // Gain Estimations
        RKMON_ECHO_PATH_GAIN,                               //
        ECHO_PATH               FLOAT - Gain [dB]
        RKMON_EC_GAIN,                                          //
        SPKP_MODULE             FLOAT - Gain [dB]
        RKMON_RES_ECHO_GAIN,                                //
        SPKP_MODULE             FLOAT - Gain [dB]

        RKMON_INIT_GAIN,
        RKMON_MAX_GAIN,
        RKMON_FULL_DUPLEX_MEASURE,

        RKMON_TONE_DETECT,

        RKMON_NOISE_INSERTION_LENGTH,
        RKMON_NOISE_INSERTION_ENABLE,

        RKMON_FADE_IN_LENGTH,
        RKMON_FADE_IN_ENABLE,

        RKMON_UPSTEP,

        RKMON_MIN_LINE_OUT_POWER,

        RKMON_DMP_MASK,

        RKMON_LINE_OUT_SILENCE_GAIN_REDUCTION,

        RKMON_INITIAL_FULL_DUPLEX_MEASURE,
```


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```
    // ********* Voice Constants **********
          RKMON_VOICE_AVG_POWER = VOICE_RK_CODES,

5   } RK_MON_CODES;

    // SPKP Modules
    typedef enum {
          LINEIN_AMP,
10        LEC,  TONE_DET,  RX_SD,  RX_SW_LOSS,  RX_AGC,
          SPKR_AMP,
          MIC_AMP,
          AEC,  TX_SD,  TX_SW_LOSS,  TX_AGC,
          LINEOUT_AMP,
15  ALL_MODULES
    } SPKP_MODULE;

    // SPKP Probing points
    typedef enum {
20        LINEIN,
          LEC_IN,  LEC_OUT,  RX_AGC_OUT,
          SPKR,
          MIC,
          AEC_IN,  AEC_OUT,  TX_AGC_OUT,
25        LINEOUT,
          ALL_PROBES
    } SPKP_PROBE;

    // Gain Format:  dB  or  Scaled 0-255
30  typedef enum { SCALED , DB , LINEAR }  GAIN_FORMAT;

    // Echo Path
    typedef enum { ACOUSTIC , LINE }  ECHO_PATH;

35  // Error Control Mode
    typedef enum { EC_FORCED, EC_OFF, EC_ON} ERROR_CONTROL_MODE;

    // Modem global state
    typedef enum {    STATE_INITIALIZING, STATE_IDLE, STATE_ORIGINATE,
40  STATE_ANSWER,
                          STATE_V8BIS_HS,   /* STATE_MST, */ STATE_TRAINING,
    STATE_CONNECTED,
                          STATE_ESCAPED, STATE_LAL, STATE_LAL_ESCAPED,
    STATE_RDL} MODEM_STATE;
45
    // Compression Mode
    typedef enum { CMPRS_OFF, CMPRS_ON} COMPRESSION_MODE;

    #endif      // _MODEM_CODES_H_
```


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Appendix C

```
#include "dlldefs.h"
#include "ModemCtrl.h"
#include "appinterface.h"

#define MAX_ERRORMSG_LEN      200


HANDLE            hModCtrlVxd = NULL;
char        ErrorMsg[MAX_ERRORMSG_LEN];

HANDLE WINAPI ModemOpen( DWORD Code )
{
      PCLIENT_INFO      pClient;

      if ( hModCtrlVxd == NULL || hModCtrlVxd == INVALID_HANDLE_VALUE ) {
#ifndef WINDOWS_NT
            hModCtrlVxd = CreateFile( "\\\\.\\MODCTRL.VXD", 0, 0, NULL,
                                      0, FILE_FLAG_DELETE_ON_CLOSE,
NULL);
#else
            hModCtrlVxd = CreateFile("\\\\.\\MODCTRL0",
                                     GENERIC_READ | GENERIC_WRITE,
                                     FILE_SHARE_READ,
                                     NULL,
                                     OPEN_EXISTING,
                                     0,
                                     NULL);
#endif
            if ( hModCtrlVxd == INVALID_HANDLE_VALUE ) {
                  strncpy( ErrorMsg, "Failed to load MODCTRL.VXD",
                              MAX_ERRORMSG_LEN );
                  return FALSE;
            }
      }
      unsigned long     nBytes;

      BOOL rc = DeviceIoControl( hModCtrlVxd,
                                                DP_OPEN_MODEM,
                                                &Code, sizeof(DWORD),
                                                &pClient,
sizeof(PCLIENT_INFO) ,
                                                &nBytes, NULL );
      if ( rc == 0 ) {
            strncpy( ErrorMsg, "DeviceIoControl with Code DP_OPEN_MODEM
Failed",
                              MAX_ERRORMSG_LEN );
            return NULL;
      }


      return (HANDLE)pClient;
```


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```
}

BOOL WINAPI ModemClose( HANDLE hModem )
{
      if ( hModCtrlVxd == NULL ) {
            strncpy( ErrorMsg, "Can't close modem: ModCtrl.vxd not loaded",
                              MAX_ERRORMSG_LEN );
            return FALSE;
      }
      if ( hModem == NULL ) {
            strncpy( ErrorMsg, "Can't close modem: NULL handle",
                              MAX_ERRORMSG_LEN );
            return FALSE;
      }

      unsigned long     nBytes;
      PCLIENT_INFO      pClient = (PCLIENT_INFO)hModem;

      BOOL rc = DeviceIoControl( hModCtrlVxd,
                                                      DP_CLOSE_MODEM,
                                                      &pClient,
sizeof(PCLIENT_INFO),
                                                      NULL, 0 ,
                                                      &nBytes, NULL );
      if ( rc == 0 ) {
            strncpy( ErrorMsg, "DeviceIoControl with Code DP_CLOSE_MODEM
Failed",
                              MAX_ERRORMSG_LEN );
            return NULL;
      }
      return 1;
}

DWORD WINAPI ModemGetCodesVersion()
{
      return MODEM_CODES_VERSION;
}

BOOL WINAPI ModemConfigure(HANDLE hModem, DWORD dwConfigCode, PVOID
pInBuffer,
                              DWORD nInBufferSize, PVOID pOutBuffer, DWORD
nOutBufferSize,
                              PDWORD pBytesReturned )
{
      BOOL                    rc;
      MODEMCTRL_DATA          ModemCtrlData;
      PCLIENT_INFO            pClient = (PCLIENT_INFO)hModem;
      DWORD BytesReturned;
#ifdef WINDOWS_NT
      UPDATE_STRUCT           UpdateClient;
#endif

      if ( hModem == NULL ) {
            strncpy( ErrorMsg, "ModemConfigure failed: HANDLE is NULL",
MAX_ERRORMSG_LEN );
```


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```
            return FALSE;
        }

#ifdef WINDOWS_NT
        rc = DeviceIoControl( hModCtrlVxd,
                                        DP_UPDATE_MODEM,
                                        &hModem, sizeof(DWORD),
                                        &UpdateClient, sizeof(UPDATE_STRUCT),
                                        &BytesReturned, NULL );
        if ( rc == FALSE )
        {
            return FALSE;
        }
        if (( UpdateClient.Status == DPACTIVE ) && (UpdateClient.ID !=
RKID_WINAC)) {
#else
        if (( pClient -> Status == DPACTIVE ) && (pClient -> ID !=
RKID_WINAC)) {
#endif
            // Can't configure an active modulation, unless it is WinAC.
            strncpy( ErrorMsg, "Modem is active", MAX_ERRORMSG_LEN );
            return FALSE;
        }

#ifdef WINDOWS_NT
        ModemCtrlData.ObjectID = UpdateClient.ID;
#else
        ModemCtrlData.ObjectID = pClient -> ID;
#endif
        ModemCtrlData.CodeIndex = dwConfigCode;
        ModemCtrlData.pInBuffer = pInBuffer;
        ModemCtrlData.cbInBuffer = nInBufferSize;
        ModemCtrlData.pOutBuffer = pOutBuffer;
        ModemCtrlData.cbOutBuffer = nOutBufferSize;
        ModemCtrlData.pBytesReturned = pBytesReturned;

        rc = DeviceIoControl( hModCtrlVxd,
                                        DP_CONFIGURE_MODEM,
                                        &ModemCtrlData,
sizeof(MODEMCTRL_DATA),
                                        NULL, 0,
                                        &BytesReturned, NULL );

        if ( rc == FALSE )
            strncpy( ErrorMsg, "DeviceIoControl with Code
DP_CONFIGURE_MODEM Failed",
                            MAX_ERRORMSG_LEN );

        return rc;
}

BOOL WINAPI ModemControl( HANDLE hModem, DWORD dwConfigCode, PVOID
pInBuffer,
                            DWORD nInBufferSize, PVOID pOutBuffer, DWORD
nOutBufferSize,
```


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```
                                PDWORD pBytesReturned )
{
      BOOL                      rc;
      PCLIENT_INFO              pClient = (PCLIENT_INFO)hModem;
      DWORD BytesReturned;
#ifdef WINDOWS_NT
      UPDATE_STRUCT             UpdateClient;
#endif
      MODEMCTRL_DATA            ModemCtrlData;

      if ( pClient == NULL ) {
            strncpy( ErrorMsg, "ModemControl failed: HANDLE is NULL",
MAX_ERRORMSG_LEN );
            return FALSE;
      }
#ifdef WINDOWS_NT
      rc = DeviceIoControl( hModCtrlVxd,
                                    DP_UPDATE_MODEM,
                                    &hModem, sizeof(DWORD),
                                    &UpdateClient, sizeof(UPDATE_STRUCT),
                                    &BytesReturned, NULL );
      if ( rc == FALSE )
      {
            return FALSE;
      }
      if ( UpdateClient.Status != DPACTIVE ) {
#else
      if ( pClient -> Status != DPACTIVE ) {
#endif
            strncpy( ErrorMsg, "modem is not active", MAX_ERRORMSG_LEN );
            return FALSE;
      }

#ifdef WINDOWS_NT
      ModemCtrlData.ObjectID = UpdateClient.ID;
#else
      ModemCtrlData.ObjectID = pClient -> ID;
#endif
      ModemCtrlData.CodeIndex = dwConfigCode;
      ModemCtrlData.pInBuffer = pInBuffer;
      ModemCtrlData.cbInBuffer = nInBufferSize;
      ModemCtrlData.pOutBuffer = pOutBuffer;
      ModemCtrlData.cbOutBuffer = nOutBufferSize;
      ModemCtrlData.pBytesReturned = pBytesReturned;

      rc = DeviceIoControl( hModCtrlVxd,
                                    DP_CONTROL_MODEM,
                                    &ModemCtrlData,
sizeof(MODEMCTRL_DATA),
                                    NULL, 0,
                                    &BytesReturned, NULL );

      if ( rc == FALSE )
            strncpy( ErrorMsg, "DeviceIoControl with Code DP_CONTROL_MODEM
Failed",
```


WSDOCID: <WO__9945695A1_I_>

```
                                MAX_ERRORMSG_LEN );

        return rc;
    }

    BOOL WINAPI ModemMonitor( HANDLE hModem, DWORD dwConfigCode, PVOID
    pInBuffer,
                              DWORD nInBufferSize, PVOID pOutBuffer, DWORD
    nOutBufferSize,
                              PDWORD pBytesReturned )
    {
        BOOL                    rc;
        PCLIENT_INFO            pClient = (PCLIENT_INFO)hModem;
        MODEMCTRL_DATA          ModemCtrlData;
        DWORD BytesReturned;
    #ifdef WINDOWS_NT
        UPDATE_STRUCT           UpdateClient;
    #endif

        if ( pClient == NULL ) {
            strncpy( ErrorMsg, "ModemMonitor failed: HANDLE is NULL",
    MAX_ERRORMSG_LEN );
            return FALSE;
        }

    #ifdef WINDOWS_NT
        rc = DeviceIoControl( hModCtrlVxd,
                                    DP_UPDATE_MODEM,
                                    &hModem, sizeof(DWORD),
                                    &UpdateClient, sizeof(UPDATE_STRUCT),
                                    &BytesReturned, NULL );
        if ( rc == FALSE )
        {
            return FALSE;
        }
        if ( UpdateClient.Status != DPACTIVE ) {
    #else
        if ( pClient -> Status != DPACTIVE ) {
    #endif
            //strncpy( ErrorMsg, "Modem is not active", MAX_ERRORMSG_LEN );
            return FALSE;
        }


    #ifdef WINDOWS_NT
        ModemCtrlData.ObjectID = UpdateClient.ID;
    #else
        ModemCtrlData.ObjectID = pClient -> ID;
    #endif
        ModemCtrlData.CodeIndex = dwConfigCode;
        ModemCtrlData.pInBuffer = pInBuffer;
        ModemCtrlData.cbInBuffer = nInBufferSize;
        ModemCtrlData.pOutBuffer = pOutBuffer;
        ModemCtrlData.cbOutBuffer = nOutBufferSize;
        ModemCtrlData.pBytesReturned = pBytesReturned;
```


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```
        rc = DeviceIoControl( hModCtrlVxd,
                                        DP_MONITOR_MODEM,
                                        &ModemCtrlData,
5   sizeof(MODEMCTRL_DATA),
                                        pOutBuffer, nOutBufferSize,
                                        pBytesReturned, NULL );

        if ( rc == FALSE )
10              strncpy( ErrorMsg, "DeviceIoControl with Code DP_MONITOR_MODEM
    Failed",
                            MAX_ERRORMSG_LEN );

        return rc;
15  }

    VOID WINAPI ModemGetLastError( PCHAR pBuf, DWORD nBuf )
    {
        strncpy( pBuf, ErrorMsg, nBuf );
20  }
```


VSDOCID: <WO___9945695A1_I_>

CLAIMS

1. A communication system comprising:

a modem;

a communication channel;

the modem having internal settings representing communication parameters, the modem being communicatively coupled to the communication channel to carry out ongoing communications through the communication channel; and

a software module being remotely associated with the modem, the software module accessing the internal settings of the modem via the communication channel and performing diagnostics using the internal settings of the modem.

2. The communication system of claim 1 wherein the software module further comprises a modem interface that interacts with the software module and assists the software module in performing diagnostics using the internal parameters of the modem.

3. The communication system of claims 1 or 2 wherein the software module accesses the communication channel transparently to the ongoing communications between the modem and the communication channel when the software module performs the diagnostics using the internal parameters of the modem.

4. The communication system of claim 1 wherein the software module accesses the communication channel without detrimentally affecting the ongoing communications between the modem and the communication channel.

5. The communication system of claims 1, 2, or 4 wherein the software module performs diagnostics using the internal parameters of the modem via the same communication channel that is used to carry out ongoing communications between the modem and the communication channel.

6. The communication system of claims 1, 2, or 4 wherein the diagnostics performed by the software module comprise monitoring a data stream in the communication channel.

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7. The communication system of claims 1, 2, or 4 wherein the diagnostics performed by the software module comprise configuring the internal settings of the modem based on information obtained regarding a data stream between the modem and the communication channel.

8. The communication system of claims 1, 2, or 4 wherein the diagnostics performed by the software module comprise controlling the internal settings of the modem according to information obtained regarding a data stream across the communication channel.

9. The communication system of claims 1, 2, or 4 wherein the software module further comprises a user interactive interface for diagnostics.

10. The communication system of claims 1, 2, or 4 further comprising a plurality of software modules being associated, respectively, with each of a plurality of modems.

11. The communication system of claims 1, 2, or 4 wherein the modem is communicatively coupled to another modem via a network.

12. The communication system of claims 1, 2, or 4 wherein the software module is accessed through at least one remote computer system.

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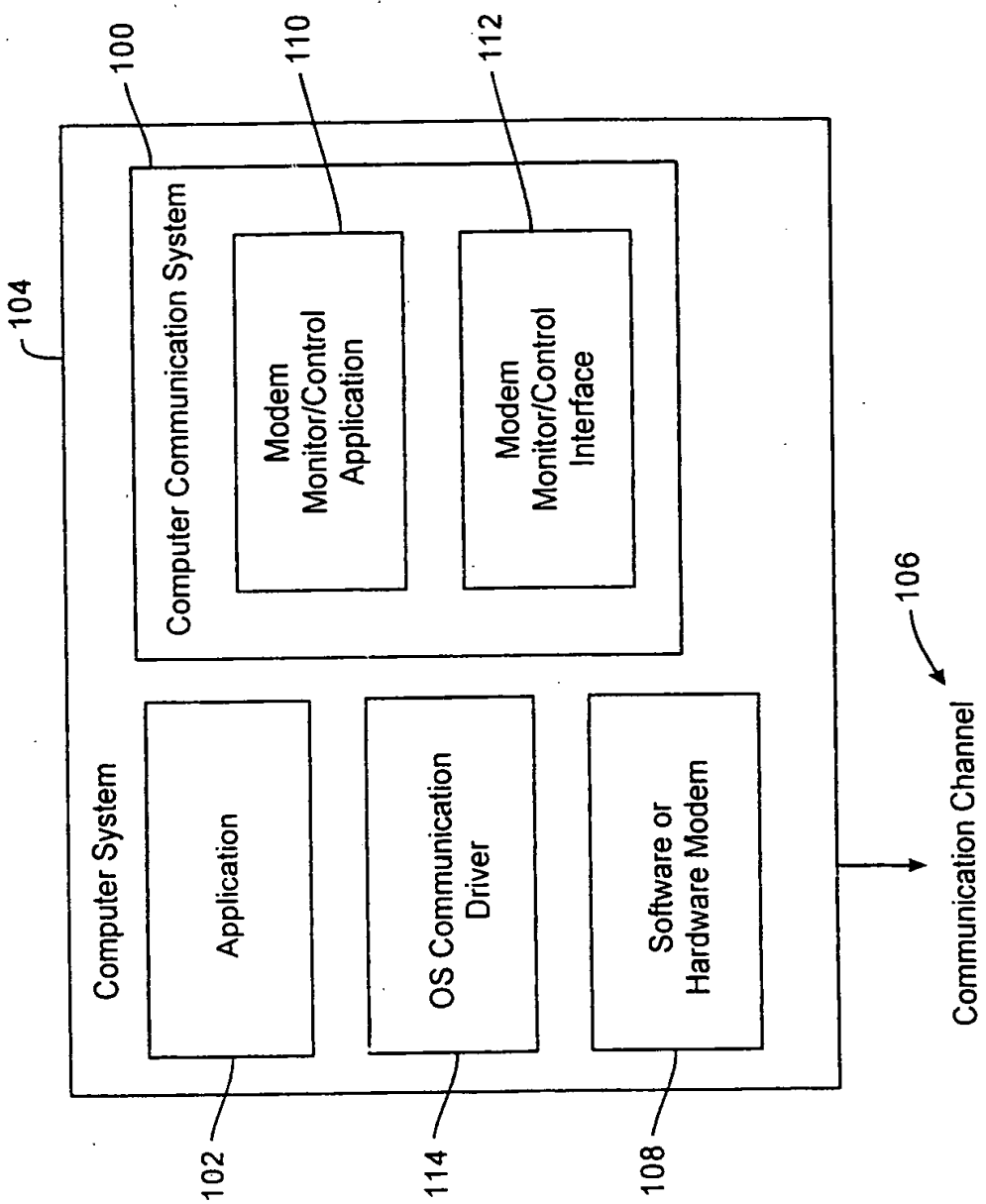

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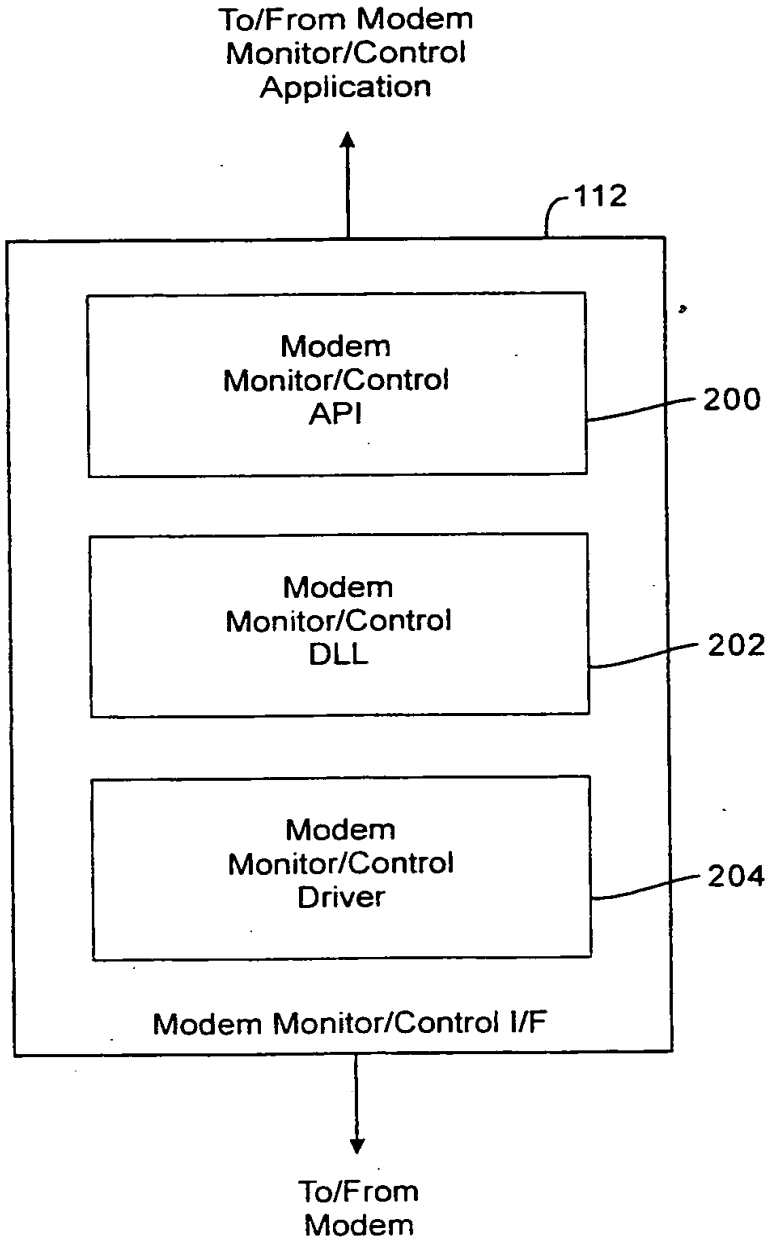
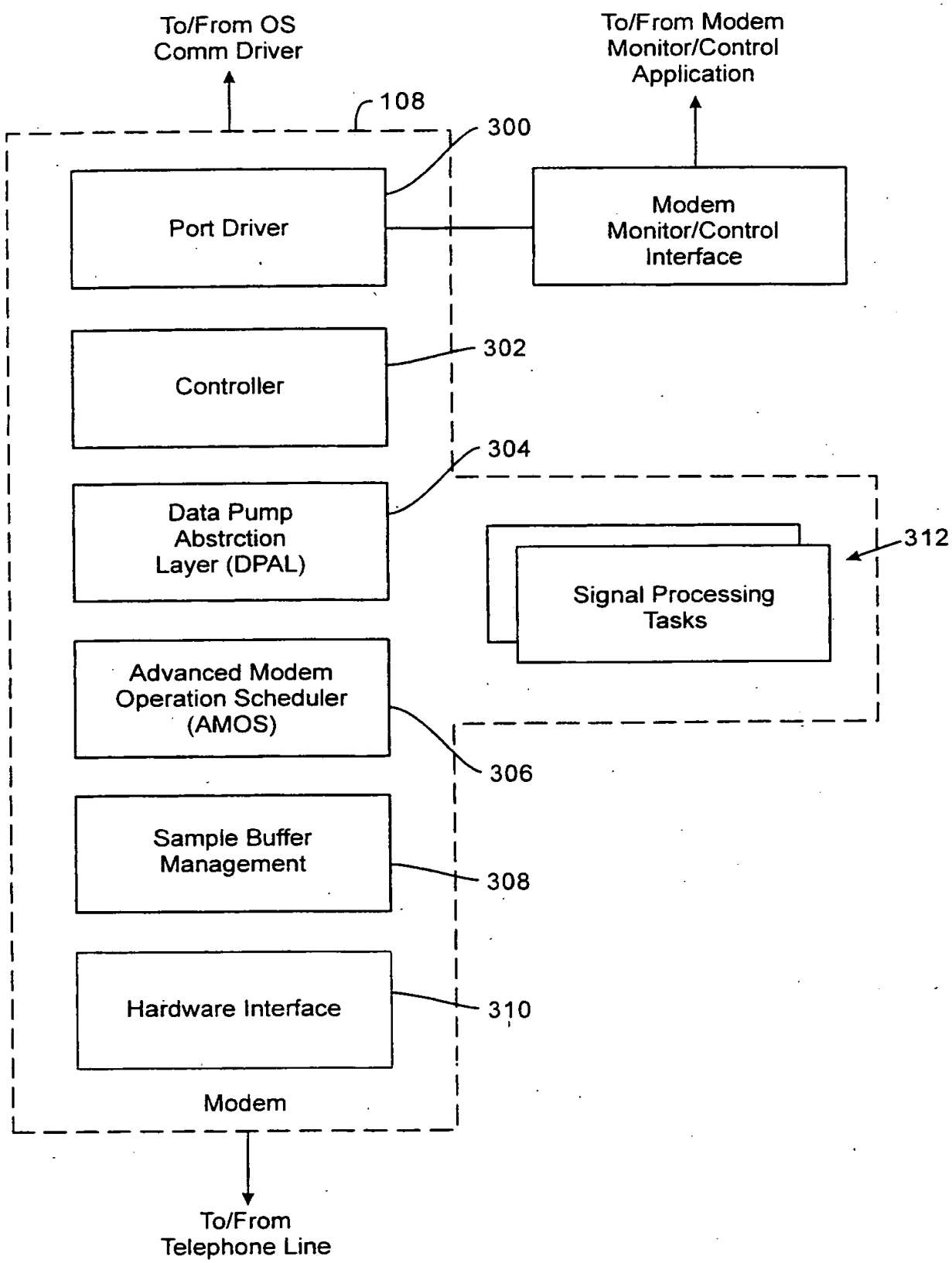


ISDOCID: <WO_ 9945695A1 I >



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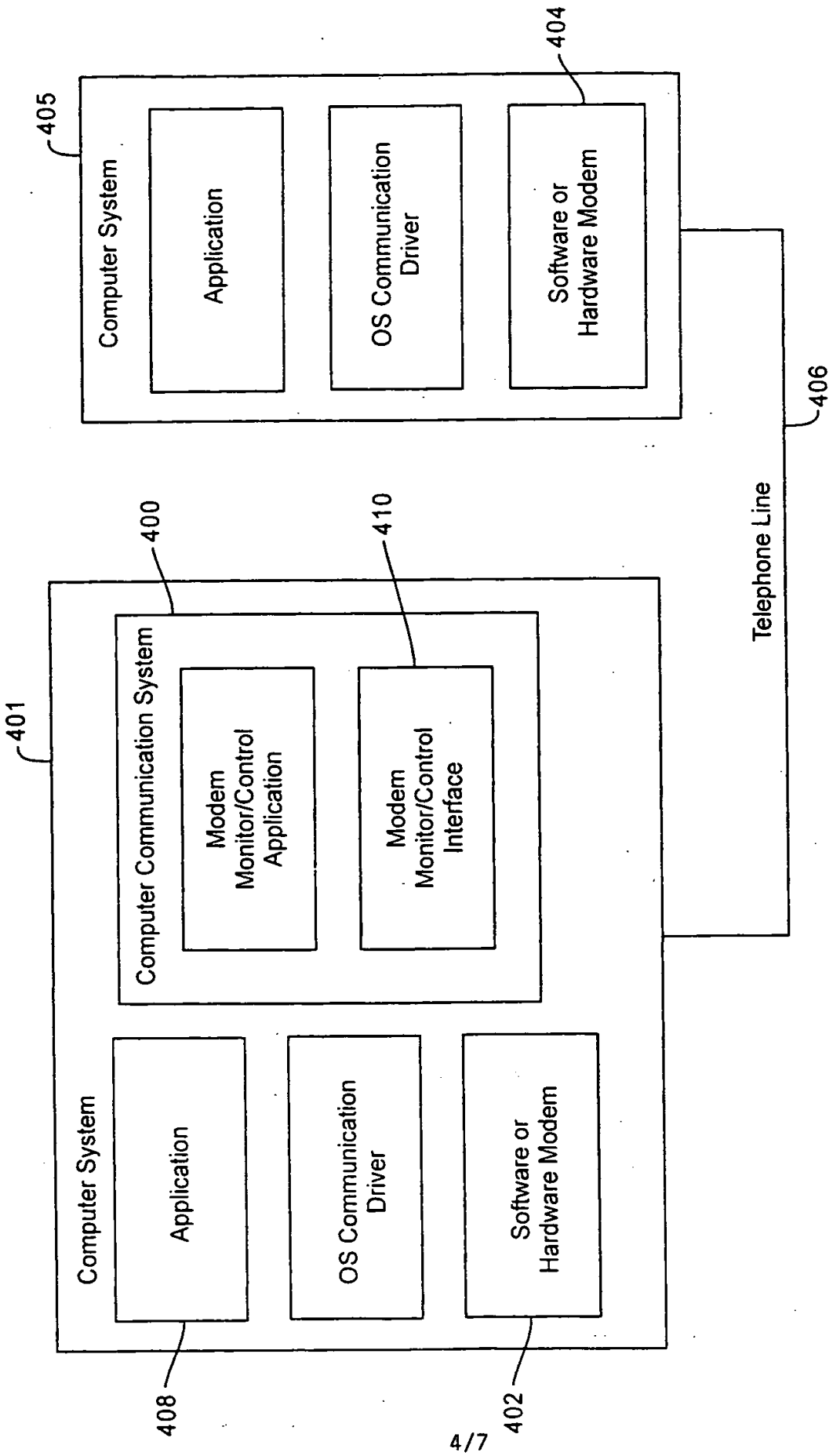

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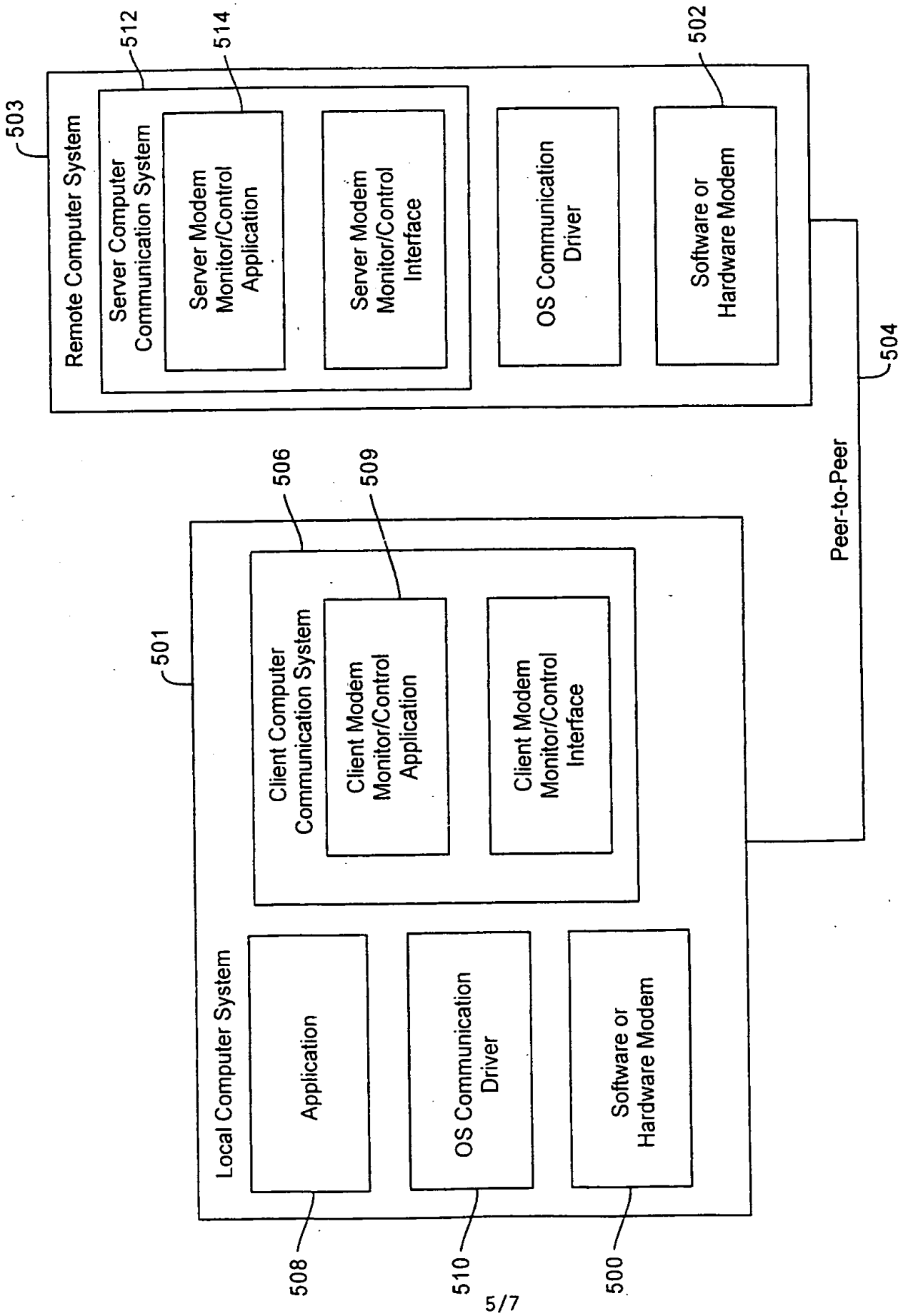
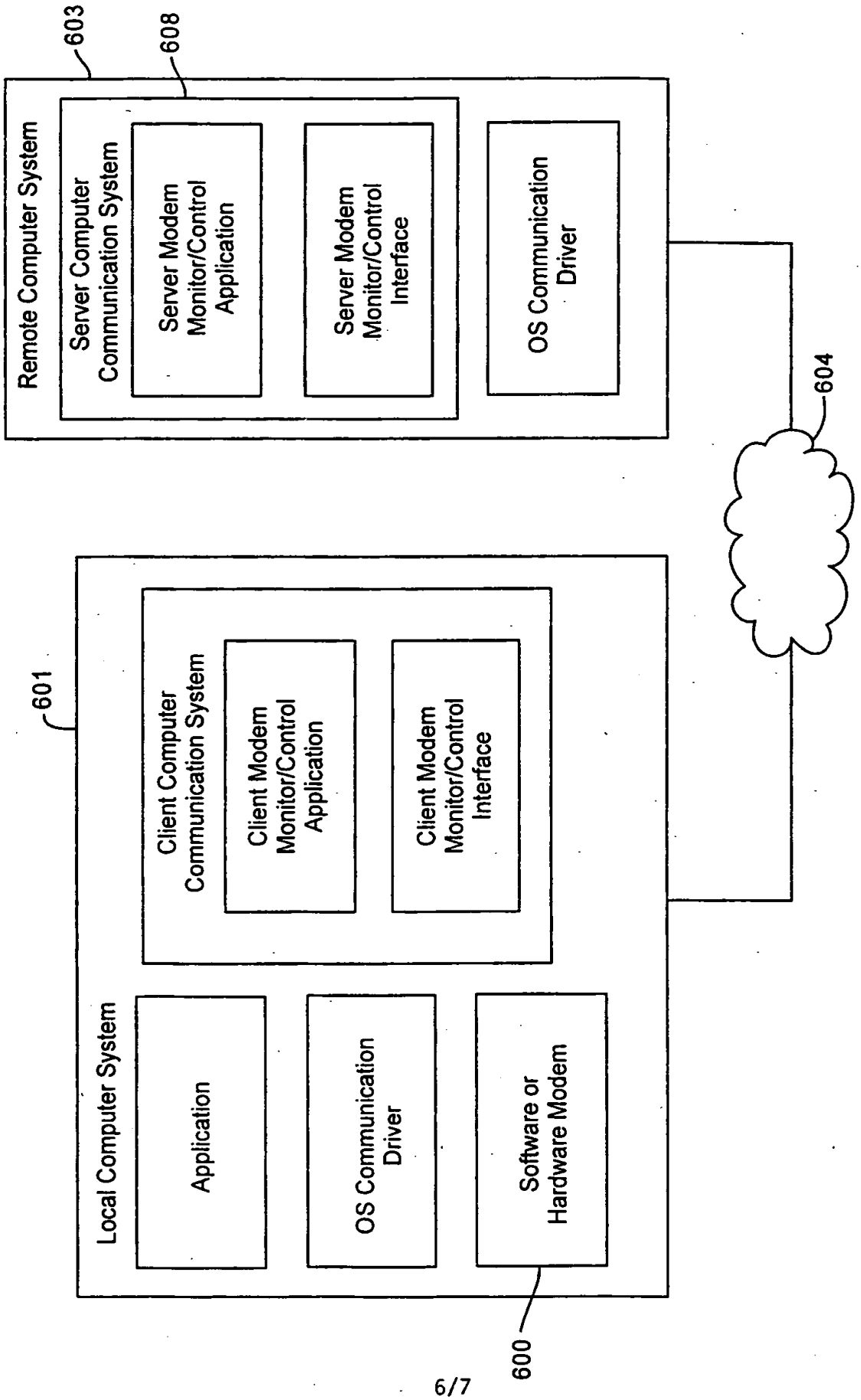


SUBSTITUTE SHEET (RULE 26)

SDOCID: <WO___9945695A1_I_>



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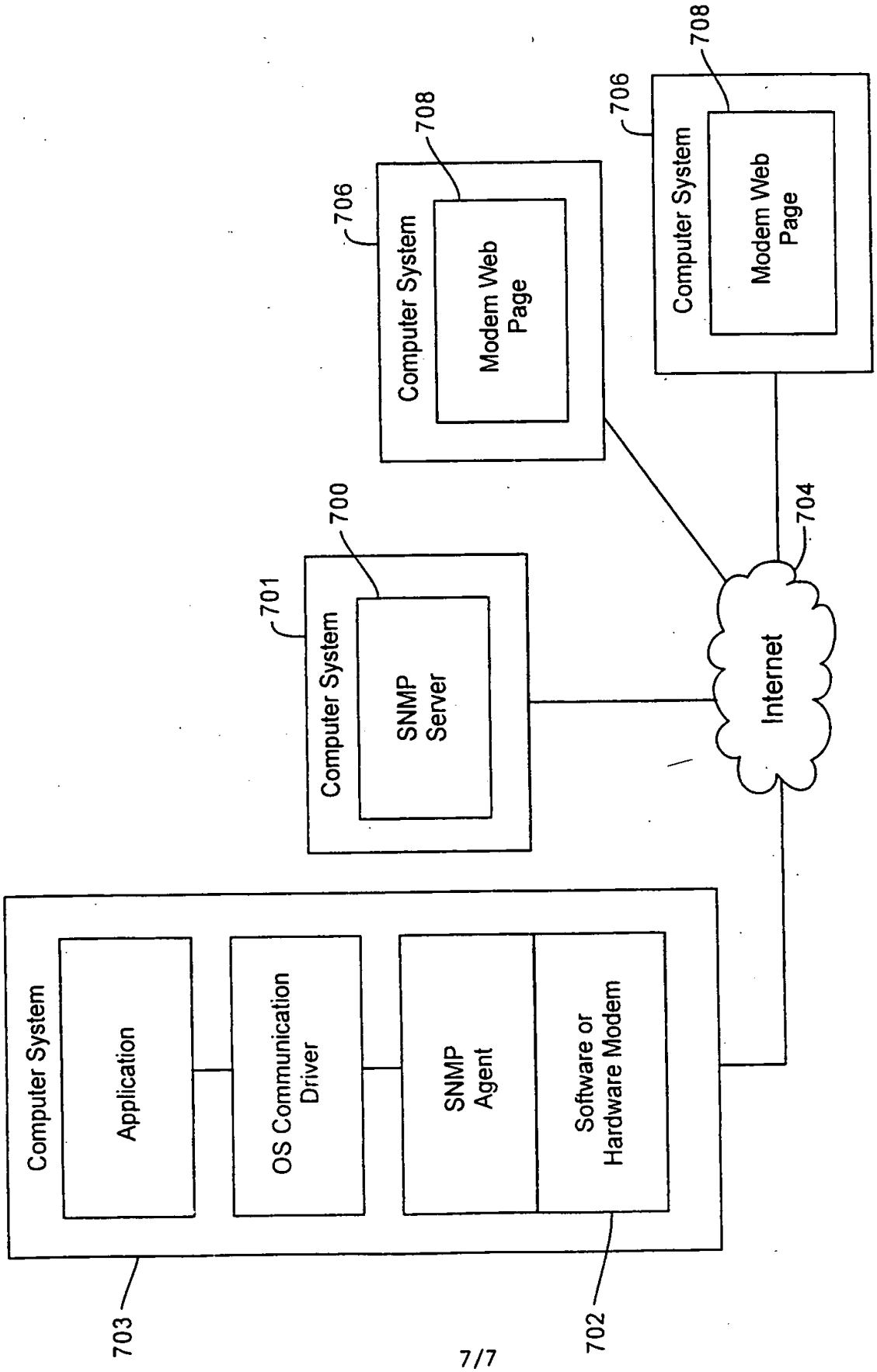

SDOCID: <WO___9945695A1_I_>

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/04841

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04M11/06 H04L12/26 H04L12/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04M H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 613 100 A (ANEZAKI AKIHIRO) 18 March 1997 see abstract see column 1, line 14 - column 3, line 4 see column 4, line 3 - column 8, line 49 see figures 1,3,21	1-4, 10-12 5-9
Y A	US 5 535 242 A (BRIGIDA DAVID J ET AL) 9 July 1996 see abstract see column 1, line 11 - column 3, line 21 see column 4, line 41 - column 6, line 9 see column 7, line 1-24 see figure 5	5 6-9

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
5 July 1999	27/07/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lievens, K

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SDOCID: <WO___9945695A1_I_>

INTERNATIONAL SEARCH REPORT

In ational Application No
PCT/US 99/04841

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 516 216 A (ARMSTRONG THOMAS R) 7 May 1985	6-9
A	see abstract see column 1, line 10 - column 2, line 55 see column 3, line 18 - column 5, line 2 see column 7, line 40 - column 8, line 19 see figure 2	1-5, 10-12
X	"Dynamic Setting of Modem Parameters" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 26, no. 1, June 1983, pages 261-262, XP002108167 US see the whole document	1,2, 10-12

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SDOCID: <WO___9945695A1_I_>

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int ... tional Application No
PCT/US 99/04841

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5613100 A	18-03-1997	JP 2062619 C	24-06-1996
		JP 3099351 A	24-04-1991
		JP 7095313 B	11-10-1995
US 5535242 A	09-07-1996	US 5528626 A	18-06-1996
		BR 9301307 A	05-10-1993
		CA 2087507 A,C	01-10-1993
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		JP 6085878 A	25-03-1994
		KR 9709296 B	10-06-1997
US 4516216 A	07-05-1985	NONE	

SDOCID: <WO___9945695A1_I_>